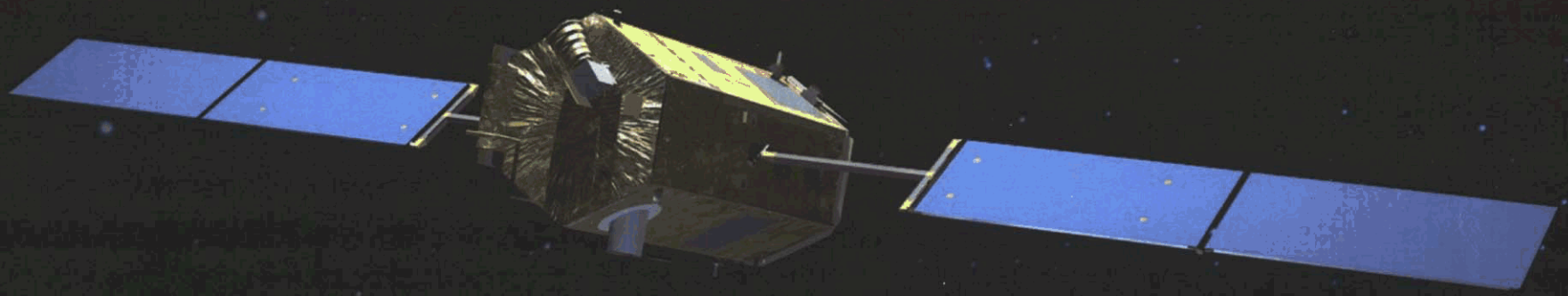
Watching the Earth breathe....
mapping CO2 from space.

Orbiting Carbon Observatory



Charles Miller

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GOSAT Symposium

27 May 2005, Tokyo Japan

http://oco.jpl.nasa.gov/

The Anthropocene: The Geology of Mankind

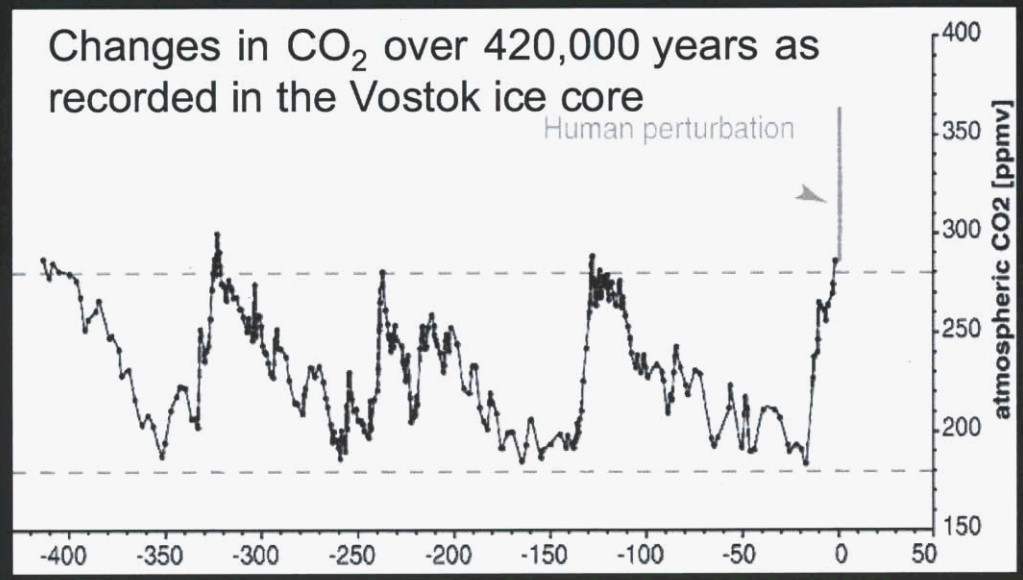
Human impact on the environment has produced measurable changes in the geologic record since the late 1700's

- **1784: Watt invents the steam engine**

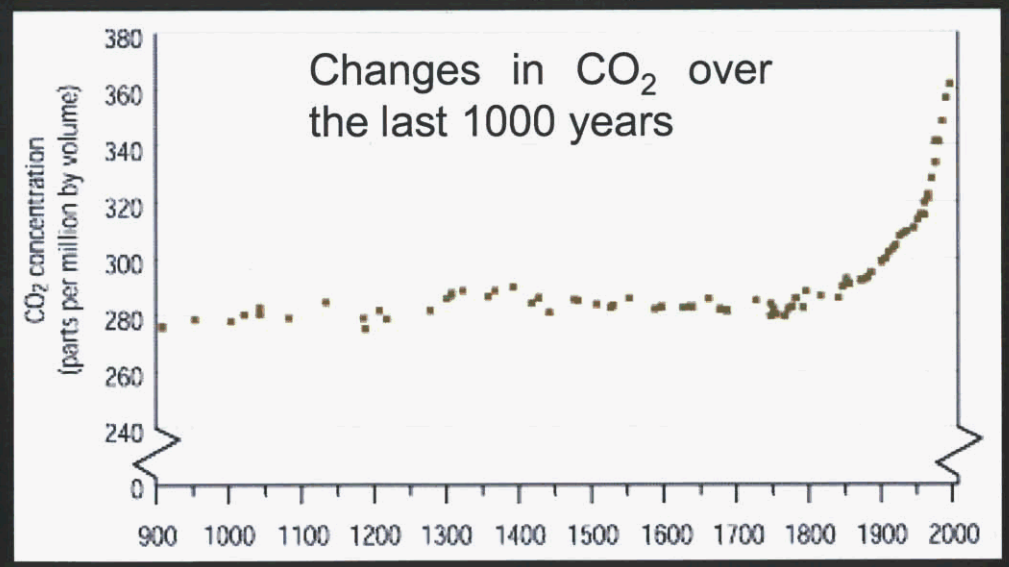
Anthropogenic emissions of CO_2 today may cause the global climate to depart from natural behavior for many millennia

'Anthropocene' defines the present human-dominated, geological epoch

Crutzen, The Geology of Mankind, Nature, Vol 415, p. 23 , 3 January 2002



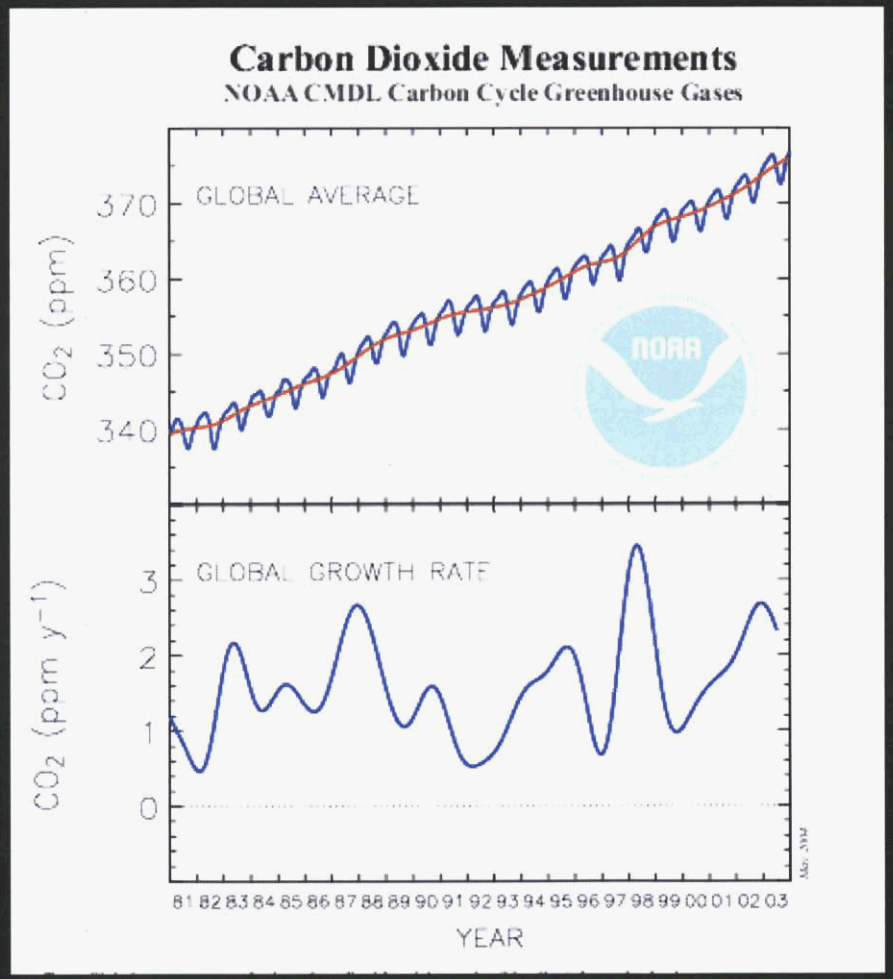
Time (kyr)

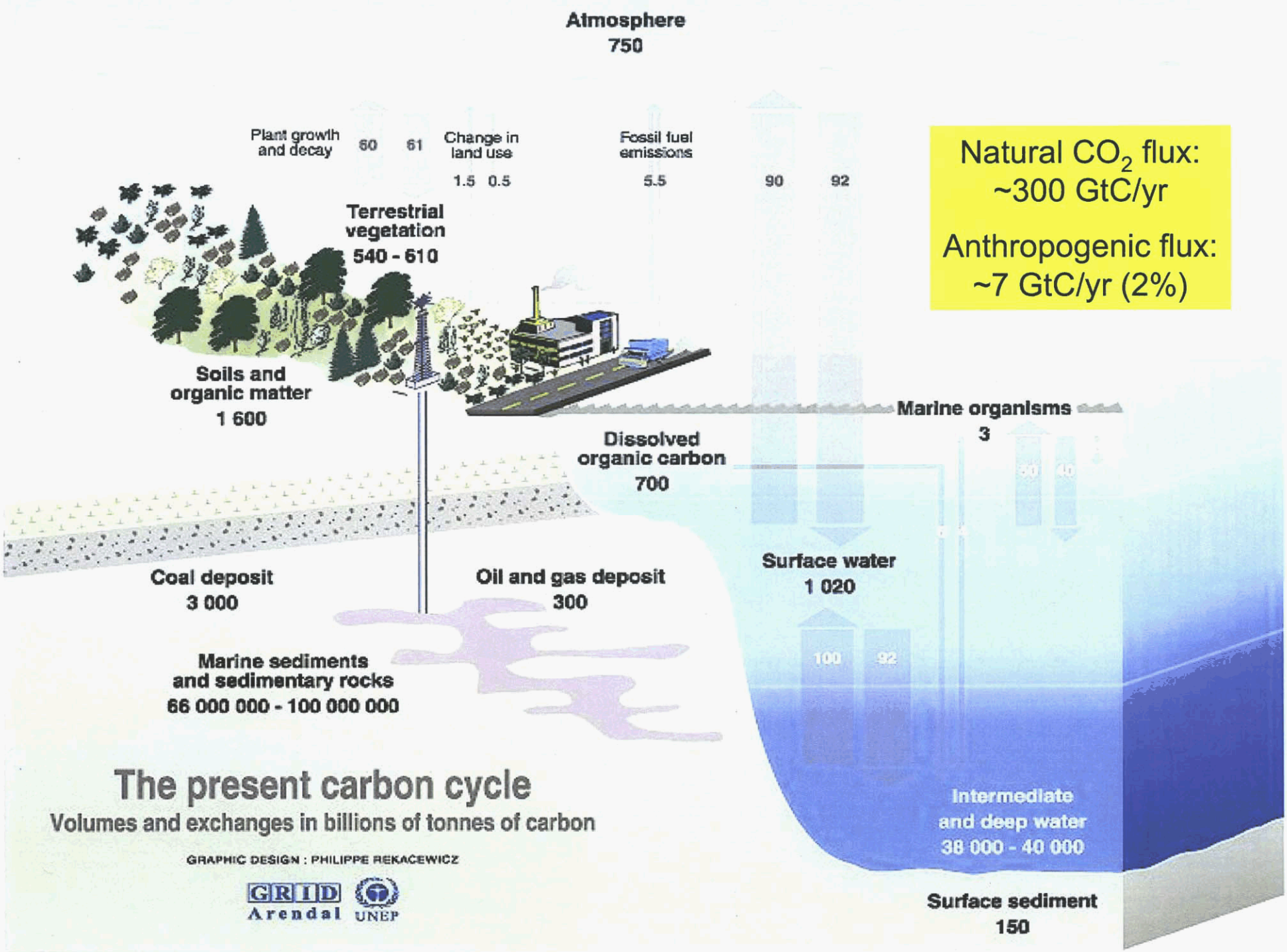


Year AD

What Processes Control Atmospheric CO_2?

- **Carbon dioxide (CO_2) is the Primary anthropogenic driver of climate change**
  - The CO_2 concentration has increased by ~25% from ~280 to 370 ppm since the beginning of the industrial age
- **Only half of the CO_2 produced by human activities over the past 30 years has remained in the atmosphere.**
  - Where are the sinks?
- **Outstanding Issues**:
  - Why does the atmospheric CO_2 buildup vary from year to year?
  - What are the relative roles of the oceans and land ecosystems in absorbing CO_2?
  - What are the relative roles of North American and Eurasian sinks?
  - How will these carbon sinks respond to climate change?





Natural CO_2 flux:
~300 GtC/yr

Anthropogenic flux:
~7 GtC/yr (2%)

How Much is 7 Gigatons of Carbon?

A Miata is about 4 meters long

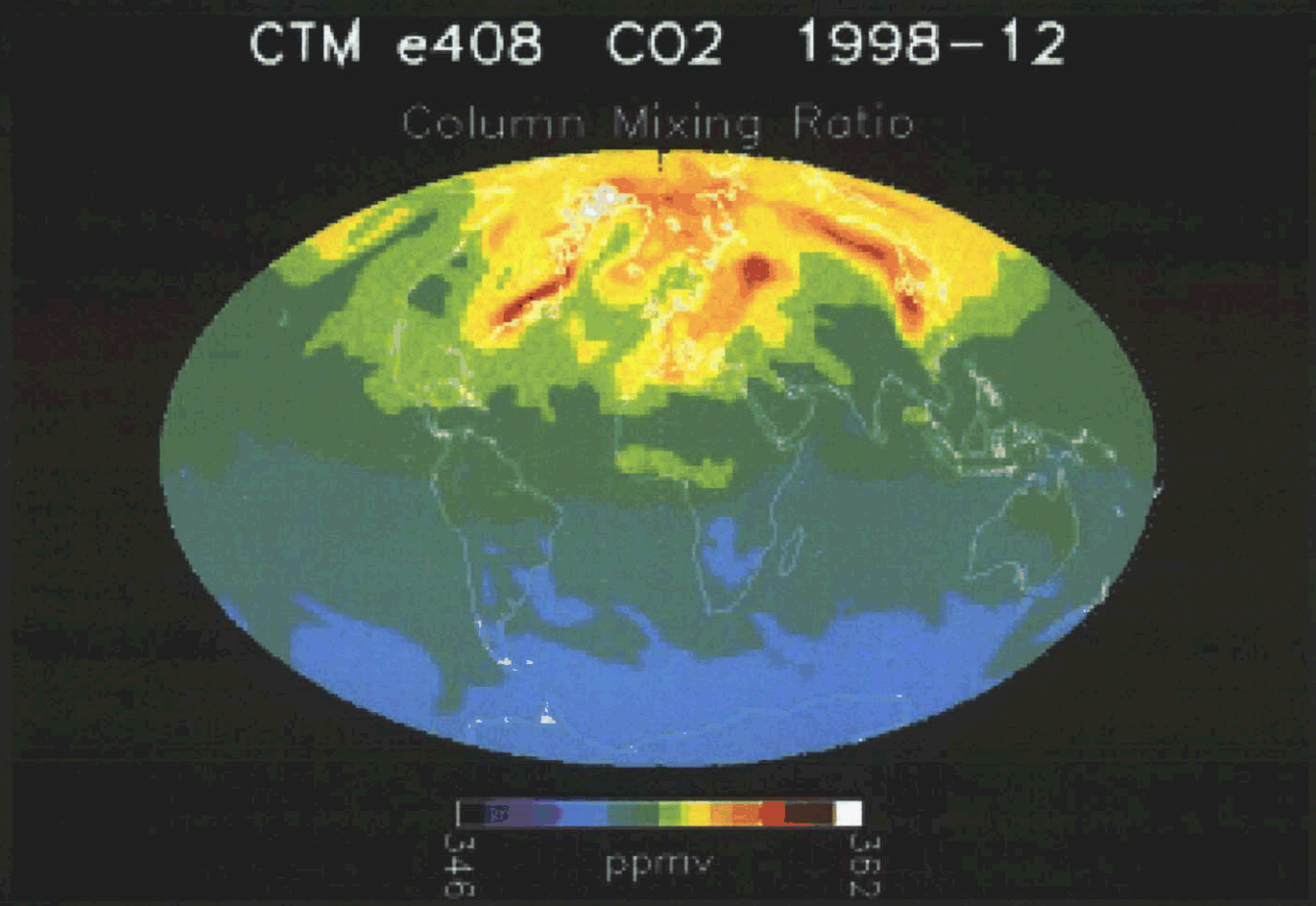
The Earth's circumference is 40,000 km
or 10,000,000 (10 million) Miatas placed end-to-end

A Mazda Miata weighs about 1 metric tonne (1000 kg)

7 GtC ~ 7,000,000,000 (7 billion) Miatas

7 GtC ~ 7,000,000,000 Miatas
or enough to encircle the Earth 700 times

Understanding CO_2 Variability



- Regional spatial scales (1000 km x 1000 km)
- Seasonal-to-interannual time scales
- Distinguish land and ocean sinks
- Understand climate/carbon cycle interactions

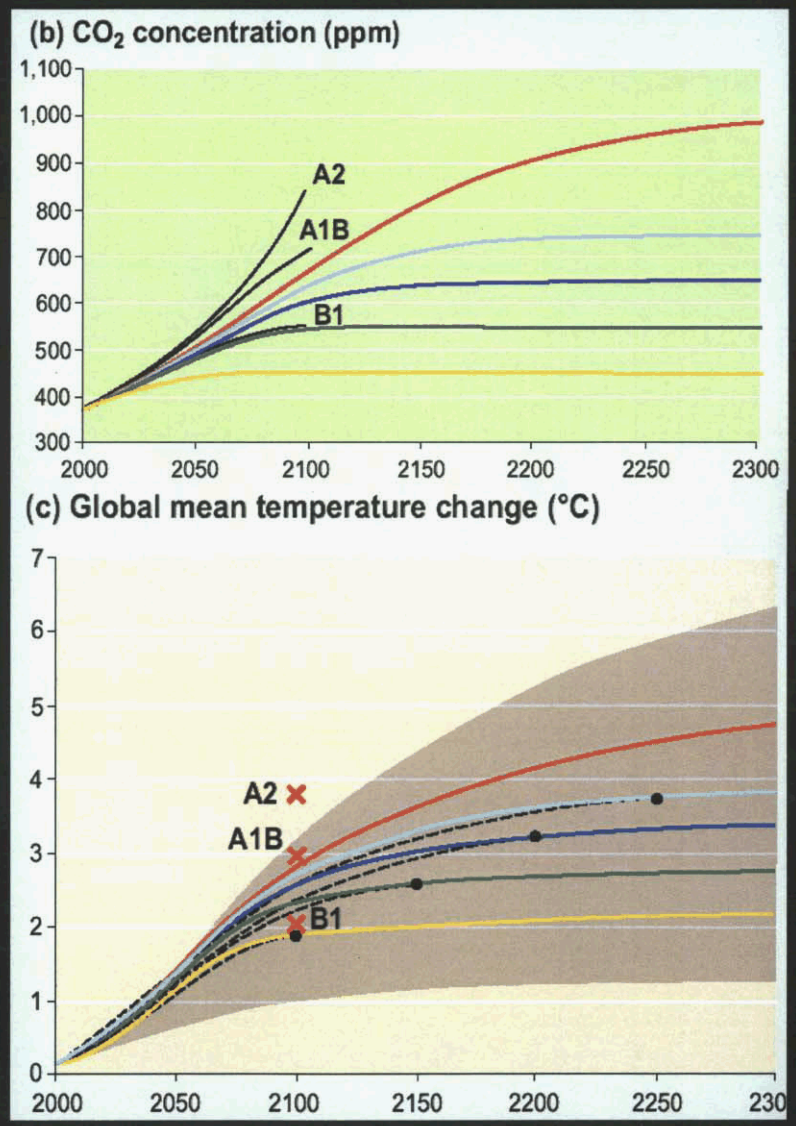
Uncertainties in Atmospheric CO_2 Equal Uncertainties in Future Climate

Future atmospheric concentrations of CO_2 are highly uncertain due to large uncertainties in

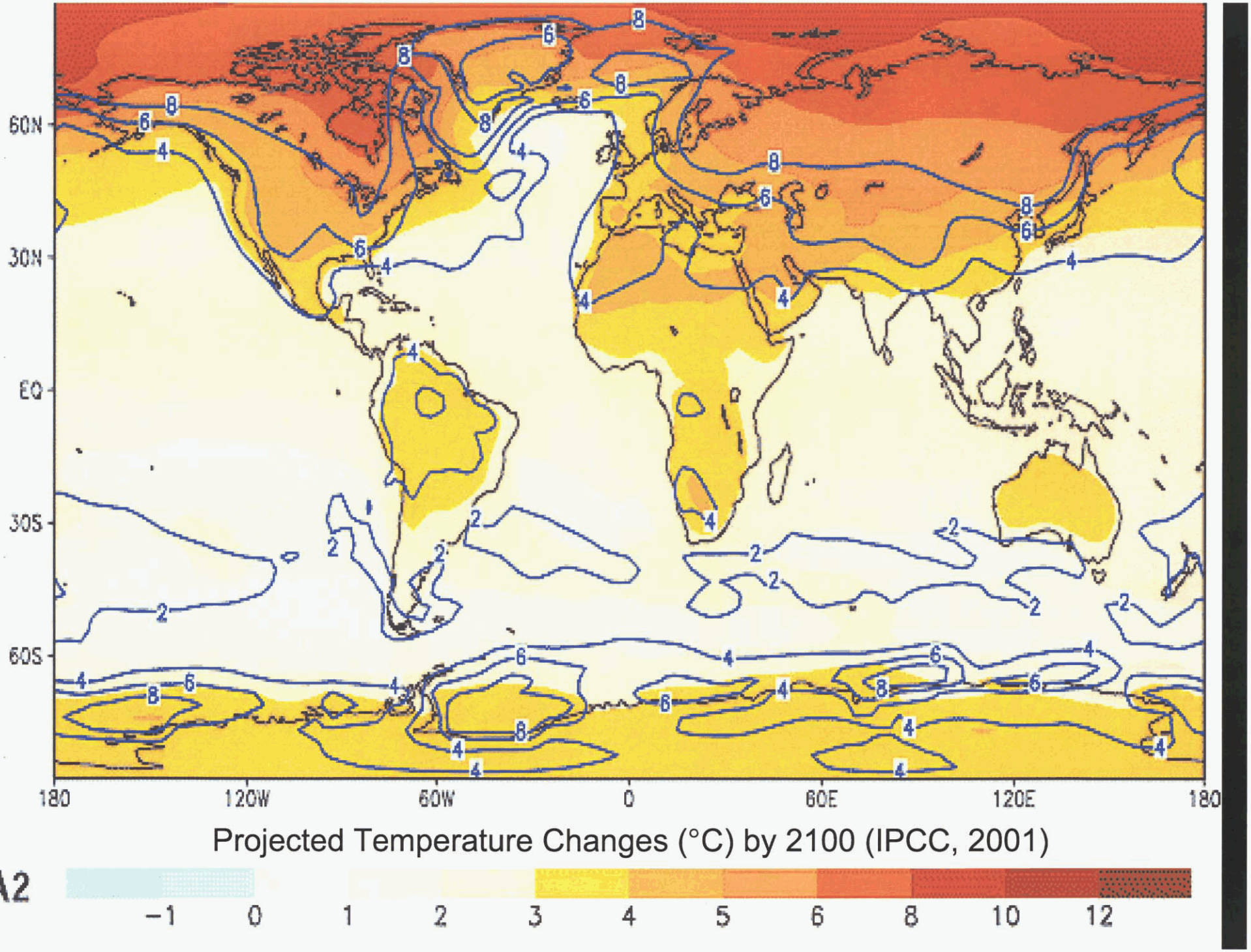
- Anthropogenic emissions
- Terrestrial sources/sinks
- Oceanic sources/sinks
- Feedback between climate and carbon sinks

The uncertainties in atmospheric CO_2 translate into large uncertainties in forecasts of global mean temperature change

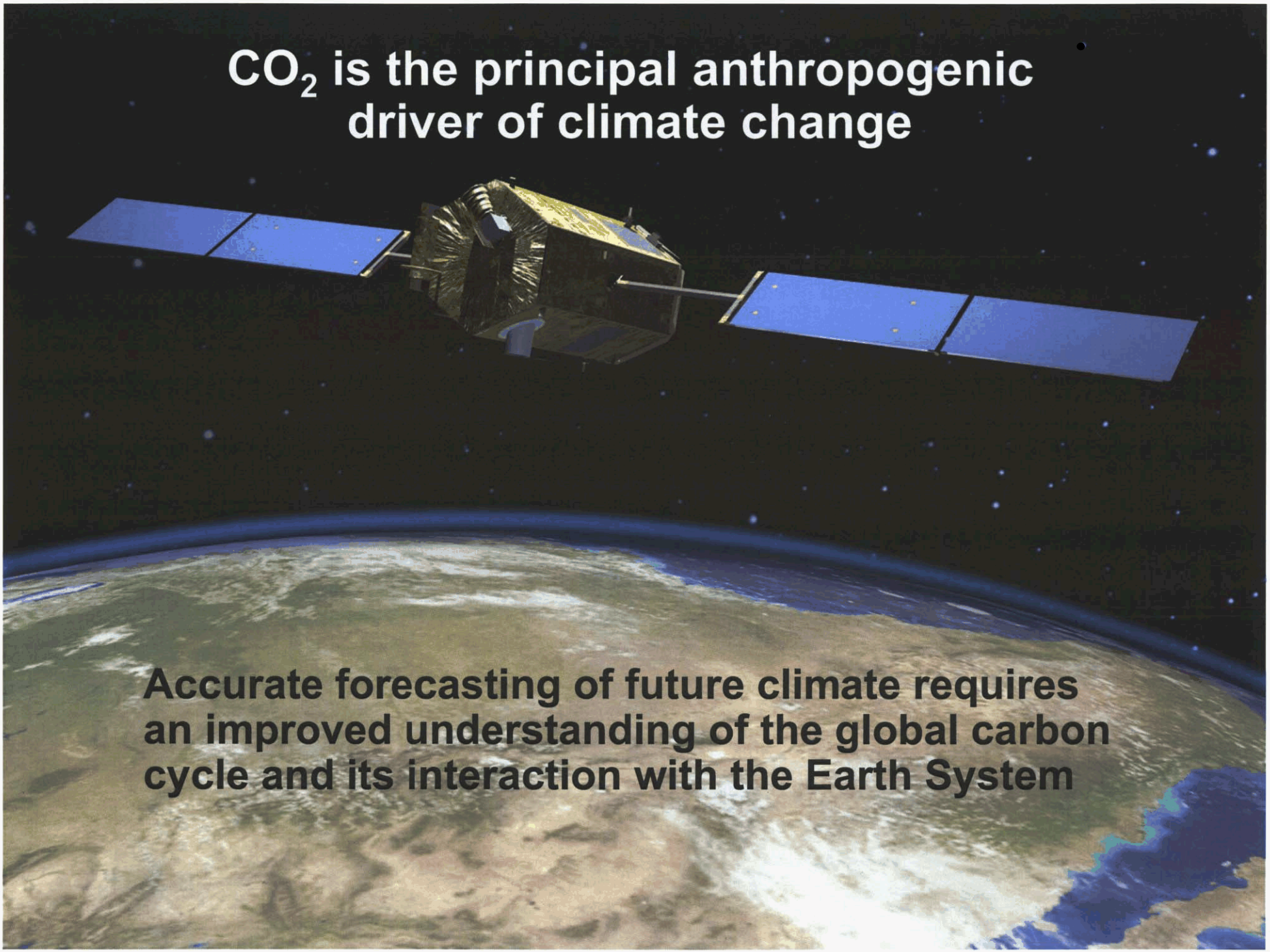
Accurate forecasts of future climate requires an improved understanding of the global carbon cycle and its interaction with the Earth System



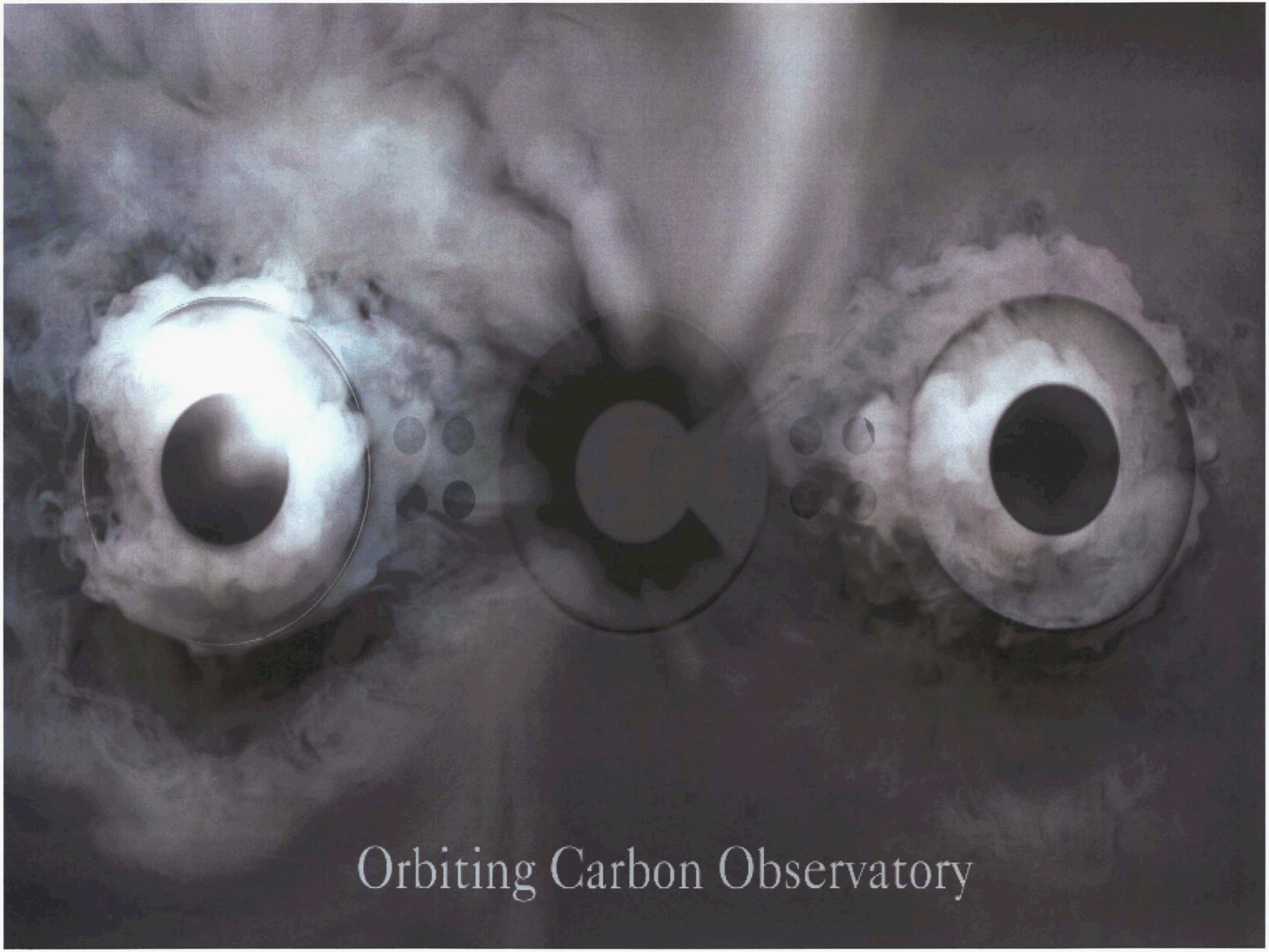
IPCC 2001 Synthesis Report



Projected Temperature Changes (°C) by 2100 (IPCC, 2001)


CO_2 is the principal anthropogenic driver of climate change
Accurate forecasting of future climate requires an improved understanding of the global carbon cycle and its interaction with the Earth System

OCO and GOSAT will revolutionize our understanding of the carbon cycle


Orbiting Carbon Observatory